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(71) Applicant (for all designated States except US): ENERSYST DEVELOPMENT CENTER, L.L.C. [US/US]; 2051 Valley View Lane, Dallas, TX 75234 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): DOBIE, Michael, J. [US/US]; 240 Twin Lakes Court, Double Oak, TX 75067 (US). NORRIS, John, Robert [US/US]; 1500 Faringdon, Plano, TX 75075 (US). COOPER, Neal, S. [US/US]; 3800 Diamond Loch West, North Richland Hills, TX 76180 (US). BACIGALUPE, Carlos [US/US]; 2017 Gardanne Lane, Carrollton, TX 75007 (US). FOREMAN, Robert, W. [US/US]; 208 Carter Drive, Euless, TX 76039 (US).

(74) Agents: DONDREA, John, A. et al.; Sidley & Austin, Suite 3400, 717 North Harwood, Dallas, TX 75201 (US).

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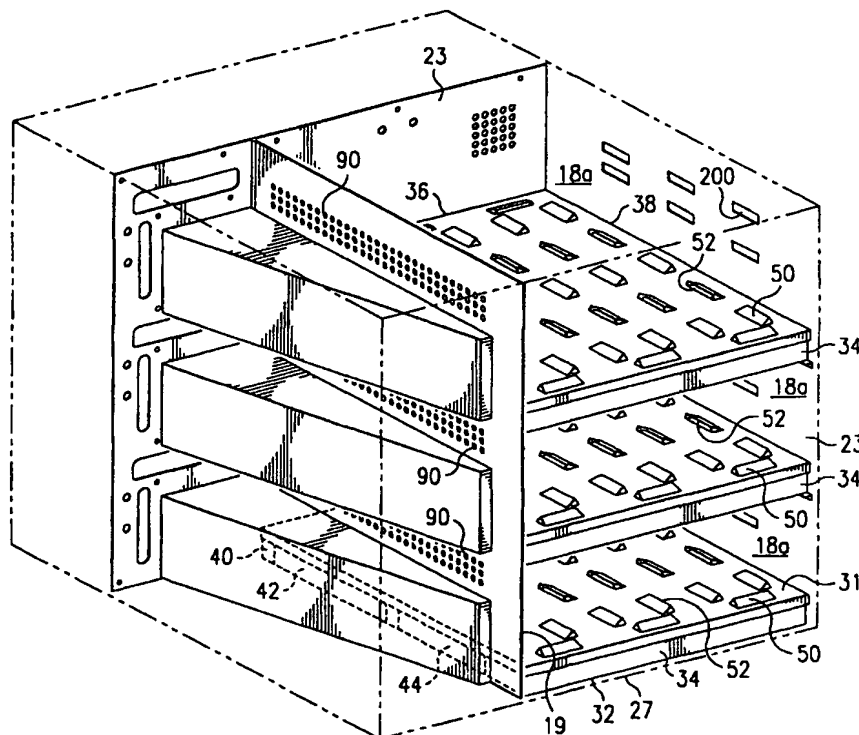
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(54) Title: MULTI-SHELVED CONVECTION MICROWAVE OVEN

(57) Abstract

An oven, is provided that includes multiple heat transfer means, including convection and microwave heat transfer means. The oven includes a cooking chamber, a blower and at least a shelf disposed within the cooking chamber. The shelf is designed to act as a food support as well as a conduit through which heated air passes into the cooking chamber. The microwave heating means comprises a microwave source and wave guide through which microwaves travel. The wave guide includes a plurality of openings through which microwaves can pass into said cooking chamber. In the preferred embodiment, the openings in the wave guide are positioned to correspond with the predetermined minima or maxima for the microwave wavelength propagating within the wave guide. An electric heating element may also be disposed within the cooking chamber to provide an alternative heating source.



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MULTI-SHELVED CONVECTION MICROWAVE OVEN

FIELD OF THE INVENTION

The present invention relates to a multi-shelved oven having multiple heating means, including convection, microwave and radiant food heating means.

5 BACKGROUND OF THE INVENTION

The oven disclosed herein relates primarily to ovens suitable for use in the commercial food service industry, such as fast food restaurants, and other food service application where there is great variety in the food products prepared, the need for speedy thermalization of food and space constraints. While various oven designs are known and
10 available for commercial food service applications, there still exists a need for an efficient and effective oven that allows for simultaneous cooking of different food products requiring different heat treatments. Single cavity ovens have been designed heretofore that include microwave and convection heat transfer cooking means. While such ovens meet the needs of certain commercial food service applications by providing rapid thermalization and cooking,
15 the inability to cook different foods simultaneously with different heating conditions and cook cycles does not provide needed flexibility. Furthermore, known combination ovens often require mechanical means to stir the microwave or move the food product in order to achieve even microwave heat transfer to the food product.

The present invention provides an oven that meets a need in the food service industry
20 for an oven provides rapid heating/cooking and the ability to cook multiple food products simultaneously under different conditions and cook cycles. Moreover, the ovens of the present invention provide a microwave heating means that does not require mechanical stirring of microwaves or movement of food products to achieve substantially uniform distribution of microwave energy into the cooking cavities of the oven.

25 SUMMARY OF THE INVENTION

The present invention provides a novel thermal food treatment system that combines multiple means of heating in a single system.

In one aspect of the invention an oven is provided that includes a cooking chamber, a blower and a shelf disposed within the cooking chamber. The shelf has a unique design in that it has an inlet opening and cavity in fluid communication with the blower and at least one opening in fluid communication with the cooking chamber through which temperature controlled air can flow into the cooking chamber to cook food by convection heating. In another aspect of the invention, the oven further comprises a microwave heating source for heating food products within said cooking chamber, thereby providing multiple heating methods (convection and microwave).

In another aspect of the invention, the microwave heating means includes a microwave source and wave guide through which microwaves travel. The wave guide includes a plurality of openings through which microwaves can pass into said cooking chamber. In a preferred aspect of the invention, the openings in the wave guide are positioned to correspond with the predetermined minima or maxima for the microwave wavelength propagating within the wave guide. That is the spacing of the wave guide openings occurs at multiples of predetermined minima and/or maxima for the microwaves within the guide generated by the microwave source, most commonly a magnetron.

In another aspect of the invention, a heating element can be mounted within the cooking chamber, providing an additional heating means. In a preferred embodiment, a movable, reflective stirrer is positioned above the heating element to reflect heat from the heating element toward a food product.

In yet another aspect of the invention the shelf includes a plurality of louvers protruding from the top surface of the shelf for supporting a food receptacle. thereby allowing air to flow freely beneath the food product or receptacle. The louvers have openings that direct temperature controlled air in a direction substantially parallel to the top of the shelf.

In a preferred embodiment of the invention, the cooking chamber comprises a first cooking cavity and a second cooking cavity and includes a first shelf and a second shelf. The first shelf has an inlet opening and cavity in fluid communication with a blower and the second shelf has an inlet opening and cavity in fluid communication with a blower. Further, both the first and second shelves have at least one opening in fluid communication with the first cooking cavity and second shelf having at least one opening in fluid communication with said second cooking cavity, respectively. In a preferred aspect of this embodiment, microwave heating is provided in the first and second cavities through wave guides, preferably a pair of wave guides associated with each cavity. The preferred wave guide

arrangement again provides a wave guide having a predetermined minima and maxima and openings in the wave guide positioned to substantially correspond the minima or maxima, thereby providing efficient and even distribution of microwave energy into the cooking cavities along the length of the wave guide.

5 In yet another aspect of the invention, the blower which supplies temperature controlled air to the cooking chamber has an exhaust opening in its housing through which a portion of the temperature controlled air is exhausted from the system. In this arrangement, the oven further includes an ambient air intake opening in fluid communication with the blower whereby the blower draws air through the intake opening to replace the exhausted
10 air.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is front view of the oven (three cavity configuration);

FIG. 2 is a front view of the interior cooking chamber of the oven (three cavity configuration);

15 FIG. 3 is a front perspective view of the interior cooking chamber and portions of the convection heat transfer and microwave heat transfer systems of the oven (three cavity configuration);

FIG. 4 is a front perspective view of the interior cooking chamber and portions of the convection heat transfer and microwave heat transfer systems of the oven (three cavity
20 configuration);

FIG. 5 is a front perspective view of the interior cooking chamber and portions of the convection heat transfer system of the oven (three cavity configuration), including the food product shelf;

FIG. 6 is a view of the interior cooking chamber depicting the electric heating element
25 within the cooking chamber;

FIG. 7 is a left side view of the oven with the left panel of the exterior cabinet removed to show portions of the convection heating system of the oven (three cavity configuration);

FIG. 8 is a perspective view of the food shelf which serves as a conduit through which
30 temperature controlled air into the cooking chamber of the oven;

FIG. 9A is a perspective view of an alternative embodiment of the shelf;

FIG. 9B is a cross section view of the alternative embodiment of the shelf depicted in FIG. 9A;

FIG. 10 is a perspective view of a product support rack;

FIG. 11 is a perspective view of an embodiment of an air delivery duct for the convection heat transfer system of the oven;

FIG. 12 is a perspective view of a preferred alternative embodiment of an air delivery duct for the convection heat transfer system of the oven;

FIG. 13A is a front view of a filter assembly for filtering air exiting the cooking chamber;

FIG. 13B is side view of the filter assembly of FIG. 13A;

FIG. 13C is schematic depiction of the accordion fold filter plate of the filter assembly of FIG. 13A;

FIG. 14 is a side view of a bracket for supporting the filter assembly of FIG. 13A on the side wall of the interior cooking chamber of the oven;

FIG. 15 is schematic depiction of a control system for the oven of the present invention (three cavity configuration);

FIG. 16 is a perspective view a two cavity configuration of the oven;

FIG. 17 is a partial perspective view of the interior cooking chamber and microwave heating system for the oven (two cavity configuration);

FIG. 18 is a perspective view of the microwave heating system for the oven (two cavity configuration);

FIG. 19 is a partial perspective view of the cooking chamber and oven configuration with partial exhaust of temperature controlled air stream;

FIG. 20 is a partial perspective view of the ambient air intake and partition chamber aspects of a preferred embodiment of the two cavity configuration of the oven; and

FIG. 21 is a perspective view of the reflective stirrer of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

The description of the invention provided below is made with reference to the drawings attached hereto. The drawings have been consecutively numbered as FIGS. 1-23.

In FIG. 1, there is shown one embodiment of the oven 10 of the present invention.

5 Oven 10 includes an exterior cabinet 12 defined by exterior side walls, exterior top and bottom walls and an exterior rear wall. Preferably said walls are constructed of a stainless steel material. Hingedly secured to the front of the oven is door 14 which permits food products to be placed in and out of the interior of the oven. A handle 16 with latching means is secured to door 14 to allow the door to be secured in a closed position during cooking. The
10 door 14 is designed by known conventional means for preventing microwave leakage from the chamber 18 while the door is closed. Referring to FIGS. 2-4, 16-17 and 19, chamber 18 is defined by interior side walls 19 and 21, back wall 23, top wall 25 and bottom wall 27 (collectively the oven chamber interior walls). Preferably said oven chamber interior walls are constructed of a stainless steel material. As depicted in FIGS. 1 and 5 (three cavity oven)
15 and FIGS. 16-17 and 19 (two cavity oven), chamber 18 further comprises a plurality of cooking cavities 18a.

Referring to the three-cavity oven of FIGS. 1-5, disposed within the chamber 18 of the oven are upper shelf 20, intermediate shelf 22 and lower shelf 24, preferably constructed of a stainless steel material. Shelves 20 and 22 are movably mounted within the oven
20 chamber 18 and are positioned atop brackets to hold the shelves in position. Bottom shelf 24 can rest on the bottom of the oven chamber or, if desired, can rest on a bracket as well. Said brackets are generally shown by reference numeral 30 and are secured to the interior side walls of the oven cavity on opposite sides of the cavity walls. By providing removable shelves they can be more easily cleaned.

25 Referring to FIGS. 2, 5 and 8, the shelves 20, 22 and 24 shall be described in greater detail. Each shelf is designed to not only support a food product but is also designed as a conduit through which temperature-controlled (e.g. heated) gas (preferably air) passes and provides convection heating to food products within each oven cavity 18a. As shown in the above referenced figures, each shelf has a top portion 31, a bottom portion 32, side portions
30 34 and 36, rear portion 38 and front portion 40, defining shelf cavity 41. Front portion 40 is disposed within the chamber of the oven adjacent interior oven chamber side wall 19. Further, the front wall 40 of each shelf has openings 42 and 44 through which temperature

controlled air can pass into the shelf cavity 41. After the temperature controlled air is disposed into the shelf cavity, the air then passes through openings 52 in louvers 50 which project from the top portion 31 of each shelf. The louvers 50 are positioned at spaced areas and permit air to exit via openings in the louvers in a direction substantially parallel to the top
5 portion of the shelf, at least as it initially exits a louver 50. The openings on louvers 50 are best seen in FIGS. 5 and 8 and are represented by reference numeral 52. When temperature controlled gases exit openings 52 into the oven cavity, food products disposed within the oven cavity are heated via convective heat transfer. One advantage of the louvered openings projecting from the shelf is that when a pan or other food receptacle is placed on the shelf,
10 heated air travels freely beneath the pan and between the louvers providing very effective convective heat transfer.

In an alternative embodiment of the shelf design, the louvers are inverted and do not project from the top of the shelf, but instead project into the shelf cavity. In this configuration the louvers act like scoops within the shelf cavity. While this configuration
15 does not allow air to flow freely beneath a food tray disposed over the openings, a wire rack 900 (FIG. 10) may be placed on the shelf to lift the food receptacle (or food) from the top surface of the shelf, thereby providing satisfactory convection heat transfer.

In yet another alternative embodiment of the shelf shown in FIGS. 9A and 9B, the top surface of the shelf 31a has vertically extending protrusions 50a, recessed areas or surfaces
20 46 and openings 48 disposed in the recesses areas. The arrows shown in FIG. 9B generally depict the direction of air travel into the shelf cavity 41a and through openings 48. Like the louver configuration (noninverted) described above, one advantage of the shelf design depicted in FIGS. 9A and 9B is that when a pan or other food receptacle is placed on the shelf, heated air travels freely beneath the pan and between the louvers providing very
25 effective convective heat transfer.

Temperature controlled air is delivered into each shelf by blower assemblies 60 (FIG. 4). As shown in FIG. 4, each blower assembly 60 comprises a blower housing 64, a blower wheel 66 and a shaft 68 operably connected to a motor which rotates each blower wheel. In the preferred embodiment of the invention, each blower wheel is turned by a single axle 68
30 which is operably connected to a motor means. A 1/10 horsepower motor has been found to be adequate. A blower wheel of the forward inclined type has also been found to be adequate. Air is drawn into the blower housing and is disposed into tapered ducts 62 which, as shown, are disposed between the cabinet side wall and the oven chamber side wall 19.

In FIG. 4, specific reference numerals are provided only with respect to the tapered duct which is in fluid communication with the lower shelf. However, the features of the lower blower and duct assemblies are essentially identical to the middle and upper blower and duct assemblies and therefore descriptions for the latter are not repeated. As shown in FIG. 4, each tapered duct has a proximal end 162 and a distal end 168. An inlet opening is provided at proximal end where temperature controlled gas from blower 60 enters the duct (i.e., inlet opening 164 is in fluid communication with the blower assembly associated with the duct). Further, each tapered duct 62 has an elongated opening 70 at the bottom inward facing wall and also has a plurality of orifices 72. As shown in this embodiment, the orifices 72 and elongated opening 70 are formed in the side wall 19 of the oven chamber 18 (FIG. 12) with the remainder of the duct 62 being formed by two tapered side walls and a top wall. Temperature controlled gases entering each duct 62 exit through openings 72 into the respective oven cavities to heat the food product contained within said cavities. Further, as shown, a portion of the air entering each duct 62 also exits through opening 70 and flows respectively into the shelf cavities 18a of shelves 20, 22 and 24. In other words, each tapered duct feeds a separate shelf (20, 22, 24) and also feeds temperature controlled air through orifices 72 above each shelf (20, 22, 24). Accordingly, as described above, convective heat transfer is achieved by the present oven design through orifices located in the oven cavity side wall above each shelf and also through the shelves themselves through the louvers disposed on the top portion of each shelf. In an alternative arrangement, the oven would not include orifices 72 and therefore all heated gas would flow from ducts 62 into the shelf associated with the duct.

Referring to FIGS. 4-7, air return openings 90 are provided in side wall 19 within each cooking cavity 18a for the return of gas from each cooking cavity to blowers 60. By providing air return ports within each cavity 18a, each cavity can function as an independent convection oven, thereby allowing cooking of different foods at different temperatures and on different cycles. In an alternative embodiment of the invention (FIGS. 13A-C and 14), the air return openings 90 may be covered by a filter assembly 300 mounted to side wall 19 by a bracket 302 or other known means to prevent food particles, grease and other materials from escaping the cooking cavity through the return openings. A preferred filter assembly 300 is shown in FIGS. 13A-C and 14 and comprises a filter frame 304 which supports a perforated metal plate 306 that is folded in an accordion fashion thereby providing a greater surface area over which return air passes before exiting the cooking chamber through the return openings.

The temperature of the circulated air or gas can be controlled by any known means. One suitable means to heat and control the temperature of the air is by well known electric heating rods 80 (i.e., Calrod) (FIG. 7) or "gas burner" (not shown). Heating rods 80 can be disposed in any suitable location. In the preferred embodiment, heat rods are placed as shown in FIG. 7 in the return air path for the oven. FIG. 7 shows just one heating rod placed between the upper and middle ducts 62 in the area between the exterior cabinet side wall and the cavity side wall 19. Preferably, a heating element is placed above each duct 62 through the openings 82 shown in FIG. 7.

As it relates to the tapered duct design, duct 62 may have a constant taper from proximal end 162 to distal end 168 as shown in FIGS. 3-5 and 7 or may have multiple degrees of taper as shown by the dashed lines in FIG. 11. As shown in FIG. 11 and denoted by the cross hatched lines, duct 62 may have a dual taper configuration, which has been found to provide even air flow from the orifices along the length of the duct. More particularly, in the dual taper configuration of duct 62, said duct has a first horizontal tapered portion 160 adjacent proximal end 162 and inlet opening 164 (i.e., the opening where air from the blower enters the duct) and a second horizontal tapered portion 166 adjacent the distal end 168. As shown, the first horizontal tapered portion 160 has a greater angle of taper than the second horizontal tapered portion 166 which has a lower slope. Preferably, the first horizontal tapered portion 160 extends approximately one-quarter to one-half of the length of the duct. The degree of taper in the first and second horizontal tapered portions may vary. Preferably, the first horizontal tapered portion tapers down 1 inch for every 1 to 3 inches of length and the second horizontal tapered portion tapers 1 inch for every 7 to 16 inches of length. By providing a dual taper, it has been found that the air is distributed more evenly along the length of the duct from proximal end 162 to distal end 168. In a most preferred embodiment of the duct 62 shown in FIG. 12, said duct not only includes the dual taper horizontally along its length described above, but also includes a vertically tapered portion 170 adjacent proximal end 162 to further enhance air flow into the duct and even distribution of heated air into the oven chamber along the length of the duct.

After the temperature controlled air enters the oven cavity 18a through the above-described orifices 72 (optionally) and shelves, air is returned to the blower housing through return openings 90 in the oven cavity side wall 19 (i.e., the cavity wall adjacent each duct 62) (see FIGS. 2-5). The air returning through openings 90 is heated by heating element 80

before entering the blower housing where the heated air is recirculated into the oven cavity through the ducts 62.

Optionally, an electric heating element 101 (e.g., Calrod heating elements) may also be disposed adjacent the top of the oven cavity so as to provide a means for broiling food products disposed on the upper shelf (see FIGS. 1, 2 and 6).

The present oven also provides means for heating food product via microwave energy. In one embodiment of the invention shown in FIGS. 2 and 3, microwaves are disposed into the oven cavity through microwave openings 200 formed in the side wall 21 of the oven cavity. Side wall 21 is disposed opposite of oven cavity side wall 19. As shown in the preferred embodiment, there are three series of openings 200, each being served by a separate magnetron assembly 210. The type (i.e. power) of magnetron used is a matter of choice and is based on well known selection factors. Use of 2450 MHz magnetrons were found suitable in the embodiment shown in FIGS. 16-18.

In the embodiment shown in FIGS. 2 and 3, each magnetron 210 feeds microwaves into and through a conduit 212 associated with the particular magnetron assembly and through the openings 200 and into the oven cavity. The openings 200 and conduit structure 212 are arranged such that a more uniform dispensing of microwave is provided within the oven cavity. A preferred configuration for the openings 200 is shown in the figures. Other configurations may also be determined and will vary according to the design and dimensions of the cooking cavity. As shown in the figures, each cavity 18a has its own independent microwave source (i.e., magnetrons assemblies). Thus, heating of food products disposed in different cavities can be provided at different rates and on different cycles by separately controlling each magnetron. A schematic representation of the heating controls for the embodiment of FIGS. 1-5 is shown in FIG. 15.

In a preferred embodiment of the invention shown in FIGS. 16-20 (two cavity design), microwave energy from magnetrons 410 is fed into each oven cavity 18a through a pair of wave guides 400, 402 (i.e., conduits) disposed above each cavity. Thus, each cavity 18a has its own independent microwave source. Each wave guide includes a plurality of openings 404, preferably slots, through which the microwaves travel into the cooking cavity. The slots 404 are spaced to provide substantially even microwave distribution along the length of the wave guide. Specifically, the slots are spaced approximately at multiples of the calculated minima or maxima for the microwaves generated by the microwave source, i.e. magnetron. The minima and maxima for a particular wave guide and magnetron are

calculated by known means. Microwave maxima and minima for various wave guide designs and microwave frequencies also can be readily determined by reference to tables published by magnetron suppliers, such as Continental Microwave & Tool Co., Inc, Hampton, New Hampshire. As shown, slots 404 are preferably disposed at angles in relation to the length of wave guides which run generally from the back towards the front of each cavity. Further, as shown in FIGS. 17-18, blowers assemblies 500 are preferably provided to cool the magnetrons 410 during operation.

In a preferred embodiment of the invention reciprocating reflective stirrers 600 are disposed above the heating elements at the top of heating chamber 18 for reflecting heat from the heating element toward the shelf below. Preferably the stirrers are made of a material that is also microwave reflective so that enhanced stirring of microwaves is achieved, thereby promoting evenness of cooking. A suitable stirrer material is stainless steel. As shown, the reflective stirrer 600 is operably connected to bearing 602 which is moved by link 604, which in turn is connected to a drive link 606 driven by motor 608.

In the embodiment of the invention shown in FIGS. 16-20, it should be noted that chamber 18 comprises two cooking cavities 18a and that two doors 700 are used to seal the oven. Another feature of an embodiment of the invention provides for the exhausting of a portion of the temperature controlled cooking air from the blower housing. Referring to FIGS. 17-19, there is shown a exhaust opening 702 in blower housing 64 through which a portion of the temperature controlled gas is exhausted from the oven via stack (or conduit) 704. The exhausting of air from the system induces ambient air to be drawn through intake opening 706 disposed at the back of the oven. Ambient air is then drawn into partition chamber 708 disposed between the upper and lower cavities 18a. Air from partition chamber 708 is then drawn through openings 710 to both the upper and lower blower assemblies 60 which are in fluid communication with the partition chamber. Exhaust air flow and "make up" ambient air flow into the system is depicted by the arrows in FIGS. 19 and 20. The location of the partition chamber between the cooking cavities of the oven is particularly advantageous since the heat from the cooking cavities heats the air in the partition chamber, thus acting as a heat exchanger to preheat ambient air.

FIGS. 1 and 16 generally depict the control panel (or controller) 450 for the embodiments described herein. Preferably, the controller 450 has the capability to control microwave heating power and cook cycle times, and is capable of being programmed for particular food cooking applications. Likewise, it also is preferable that the controller 450

control the convective heat transfer aspects of the invention (e.g., blowers 60 and heating elements) and the reflective stirrers described above.

The present invention is not limited to the examples illustrated above, as it is understood that one ordinarily skilled in the art would be able to utilize substitutes and
5 equivalents without departing from the present invention.

CLAIMS:

1. An oven comprising:
a cooking chamber;
a blower;
at least one shelf disposed within said cooking chamber, said at least one shelf having
5 an inlet opening and cavity in fluid communication with said blower, said shelf having at least one opening in fluid communication with said cooking chamber through which temperature controlled gases can flow into said cooking chamber; and at least one air return opening in said chamber in fluid communication with said blower for return of said temperature controlled gases to said blower.
2. The oven of Claim 1 further comprising a microwave heating source for heating food products within said cooking chamber.
3. The oven of Claim 1 further comprising a microwave source and wave guide through which said microwaves travel, said wave guide having a plurality of openings through which said microwaves can pass into said cooking chamber.
4. The oven of Claim 3 wherein said microwaves traveling in said wave guide have a wavelength and predetermined minima and maxima, said openings in said wave guide being positioned to substantially correspond with said minima or maxima.
5. The oven of Claim 1 further comprising a heating element within said chamber.
6. The oven of Claim 5 further comprising a movable stirrer positioned above said heating element, said stirrer being capable of reflecting heat from said heating element toward said at least one shelf.
7. The oven of Claim 6 wherein said stirrer is constructed of a microwave reflective material.

8. The oven of Claim 1 wherein said at least one shelf has a top surface and plurality of louvers protruding from said top surface for supporting a food receptacle above said top surface.

9. The oven of Claim 8 wherein said at least one opening in said at least one shelf configured to project said temperature controlled gases in a direction that is substantially parallel to said top surface of said shelf.

10. The oven of Claim 1 wherein said cooking chamber comprises a first cooking cavity and a second cooking cavity and said at least one shelf comprises a first shelf and a second shelf, said first shelf having an inlet opening and cavity in fluid communication with a blower and said second shelf having an inlet opening and cavity in fluid communication with a blower, said first shelf having at least one opening in fluid communication with said first cooking cavity and said second shelf having at least one opening in fluid communication with said second cooking cavity.

11. The oven of Claim 10 further comprising a first microwave heating source for heating food products within said first cooking cavity and a second microwave heating source for heating food products within said second cooking cavity.

12. The oven of Claim 10 further comprising:

a first microwave source and a first wave guide through which microwaves travel, said first wave guide having a plurality of openings through which said microwaves can pass into said first cooking cavity; and

5 a second microwave source and a second wave guide through which microwaves travel, said second wave guide having a plurality of openings through which said microwaves can pass into said second cooking cavity.

13. The oven of Claim 12 further comprising:

a third microwave source and a third wave guide through which microwaves travel, said third wave guide having a plurality of openings through which said microwaves can pass into said first cooking cavity; and

5 a fourth microwave source and a fourth wave guide through which microwaves travel, said fourth wave guide having a plurality of openings through which said microwaves can pass into said second cooking cavity.

14. The oven of Claim 12 wherein:

said microwaves traveling in said first wave guide have a wavelength and predetermined minima and maxima, said openings in said first wave guide being positioned to substantially correspond with said minima or maxima; and

5 said microwaves traveling in said second wave guide have a wavelength and predetermined minima and maxima, said openings in said second wave guide being positioned to substantially correspond with said minima or maxima.

15. The oven of Claim 13 wherein:

said microwaves traveling in said first wave guide have a wavelength and predetermined minima and maxima, said openings in said first wave guide being positioned to substantially correspond with said minima or maxima;

5 said microwaves traveling in said second wave guide have a wavelength and predetermined minima and maxima, said openings in said second wave guide being positioned to substantially correspond with said minima or maxima;

10 said microwaves traveling in said third wave guide have a wavelength and predetermined minima and maxima, said openings in said third wave guide being positioned to substantially correspond with said minima or maxima; and

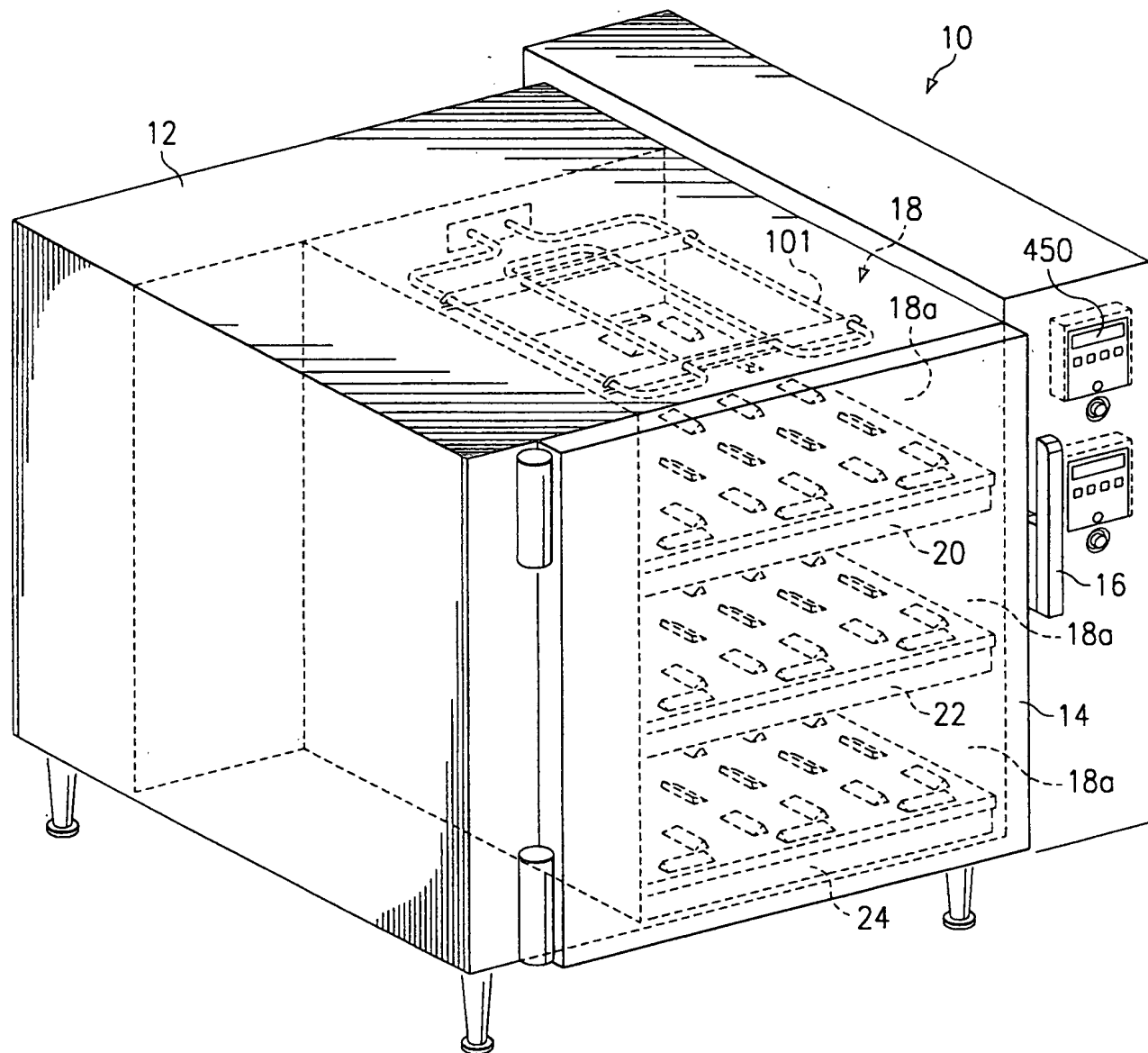
said microwaves traveling in said fourth wave guide have a wavelength and predetermined minima and maxima, said openings in said fourth wave guide being positioned to substantially correspond with said minima or maxima.

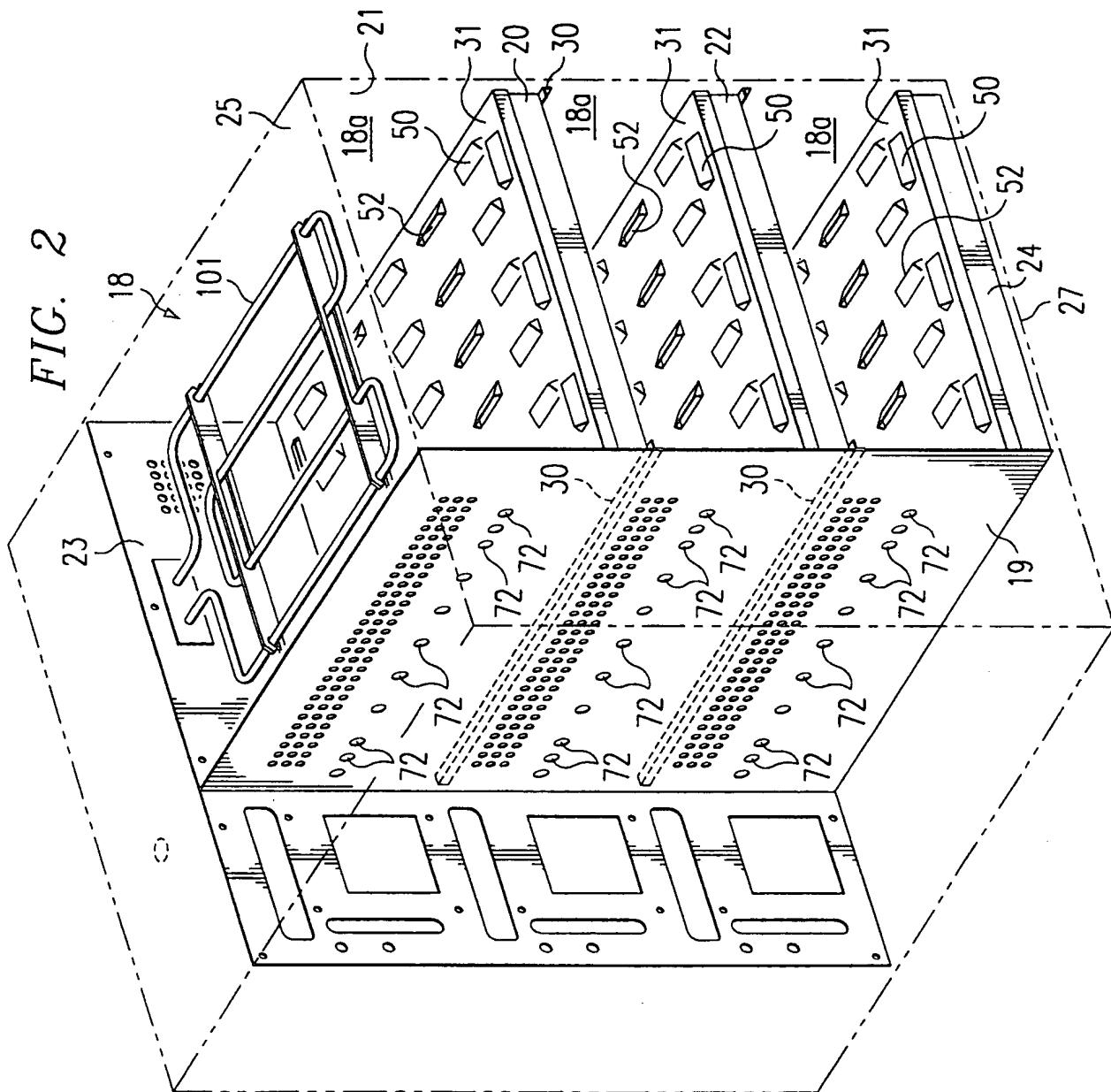
16. The oven of Claim 10 further comprising at least one air return opening in said first cooking cavity in fluid communication with a blower for return of said temperature controlled gases to said blower and at least one air return opening in said second cavity in fluid communication with a blower for return of said temperature controlled gases to said
5 blower.

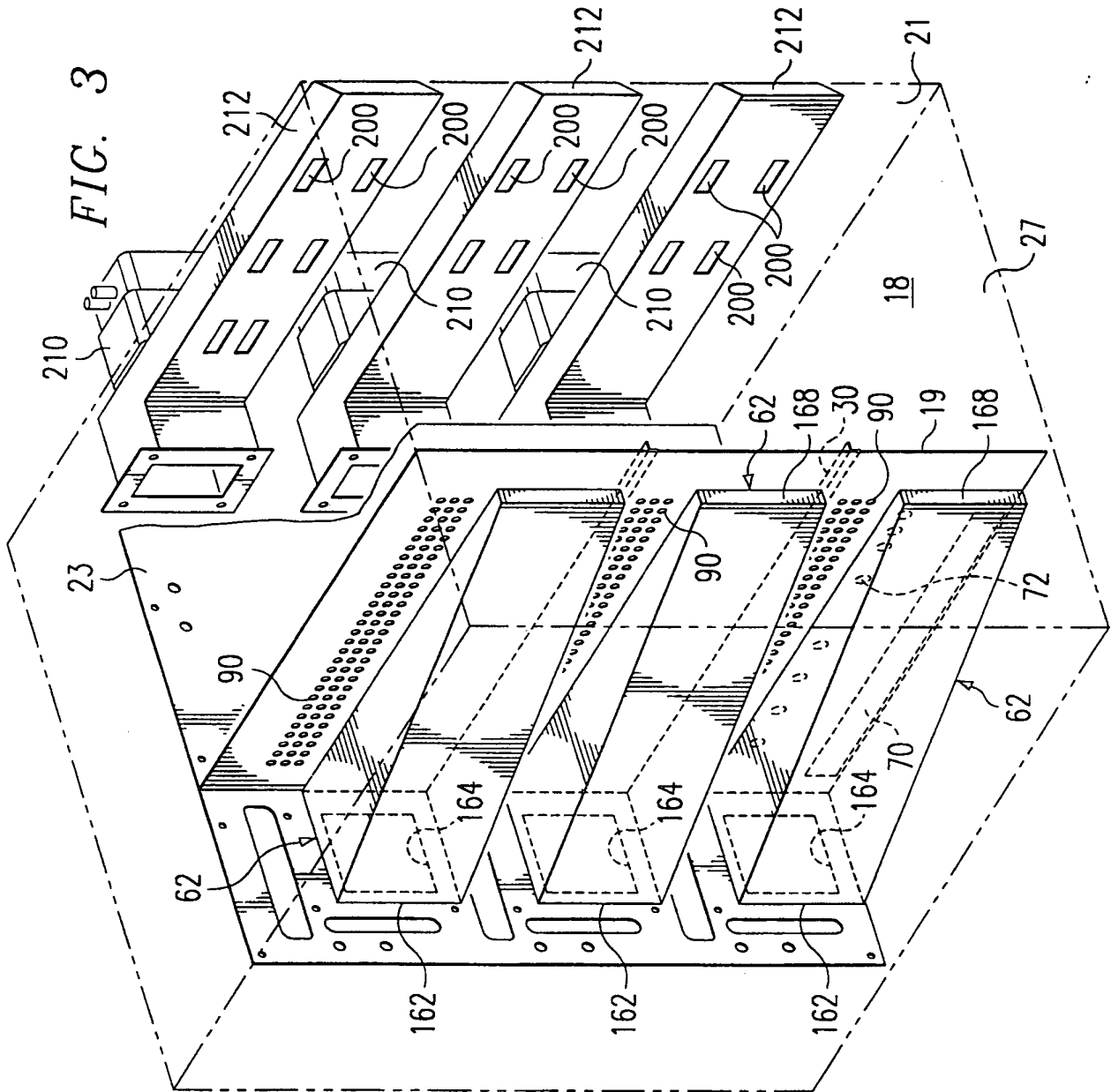
17. The oven of Claim 1 wherein said blower comprises a blower housing having an exhaust opening through which a portion of said temperature controlled air is exhausted from said blower housing, said oven further comprising an ambient air intake opening in fluid communication with a second chamber disposed between said first and second cooking
5 cavities, said second chamber being in fluid communication with said blower wherein said blower draws air from said second chamber.

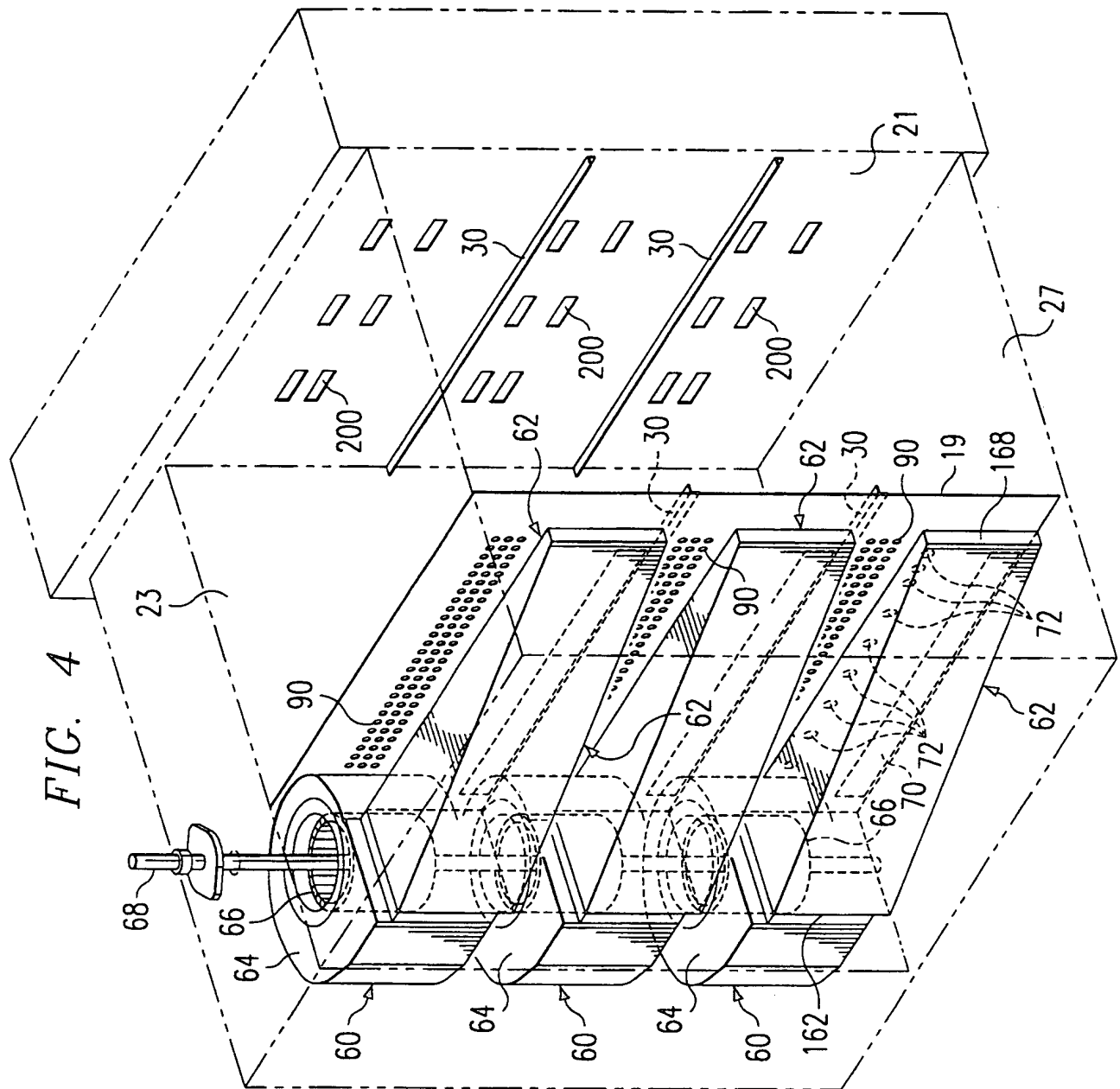
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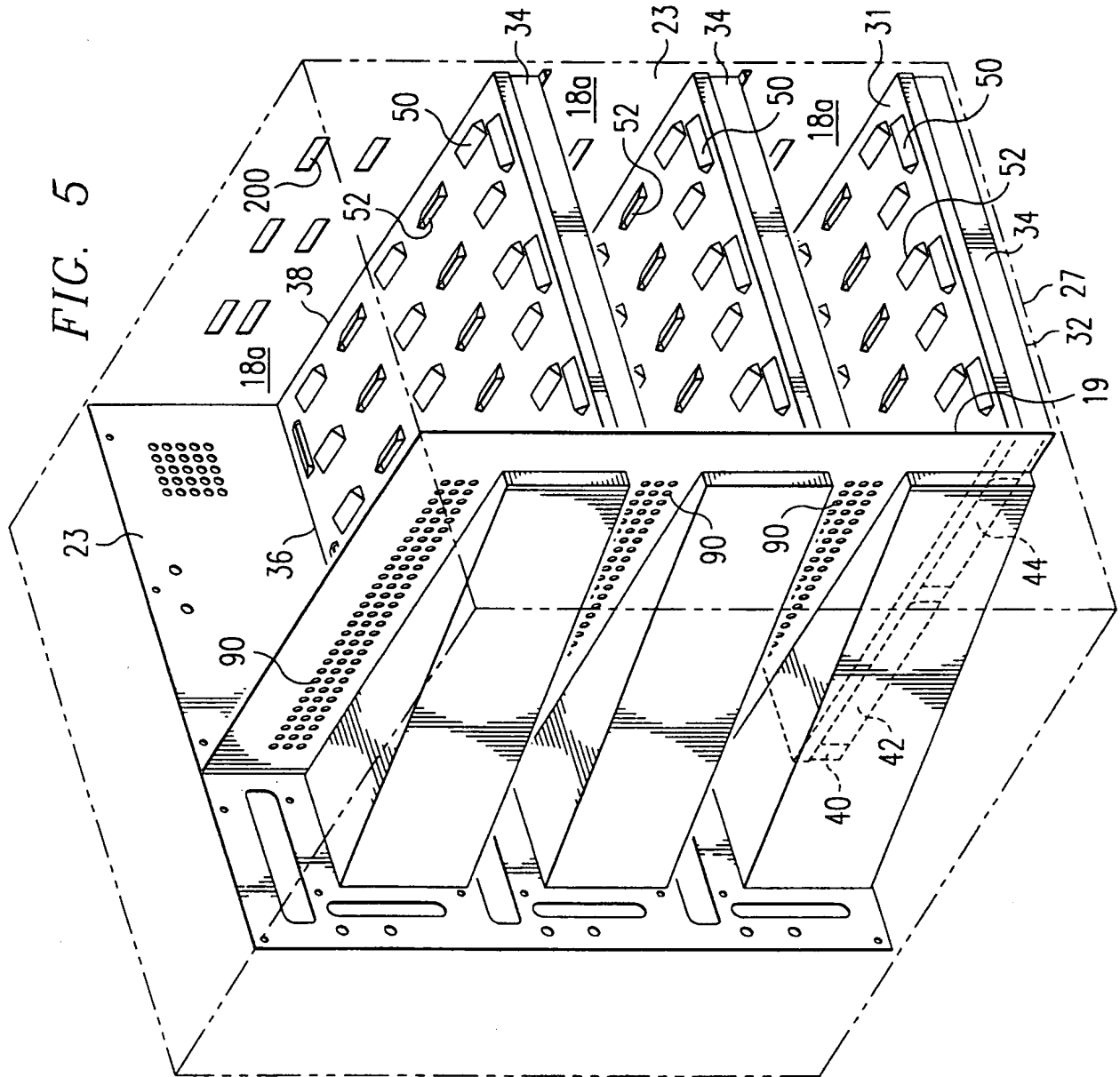
FIG. 1











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FIG. 6

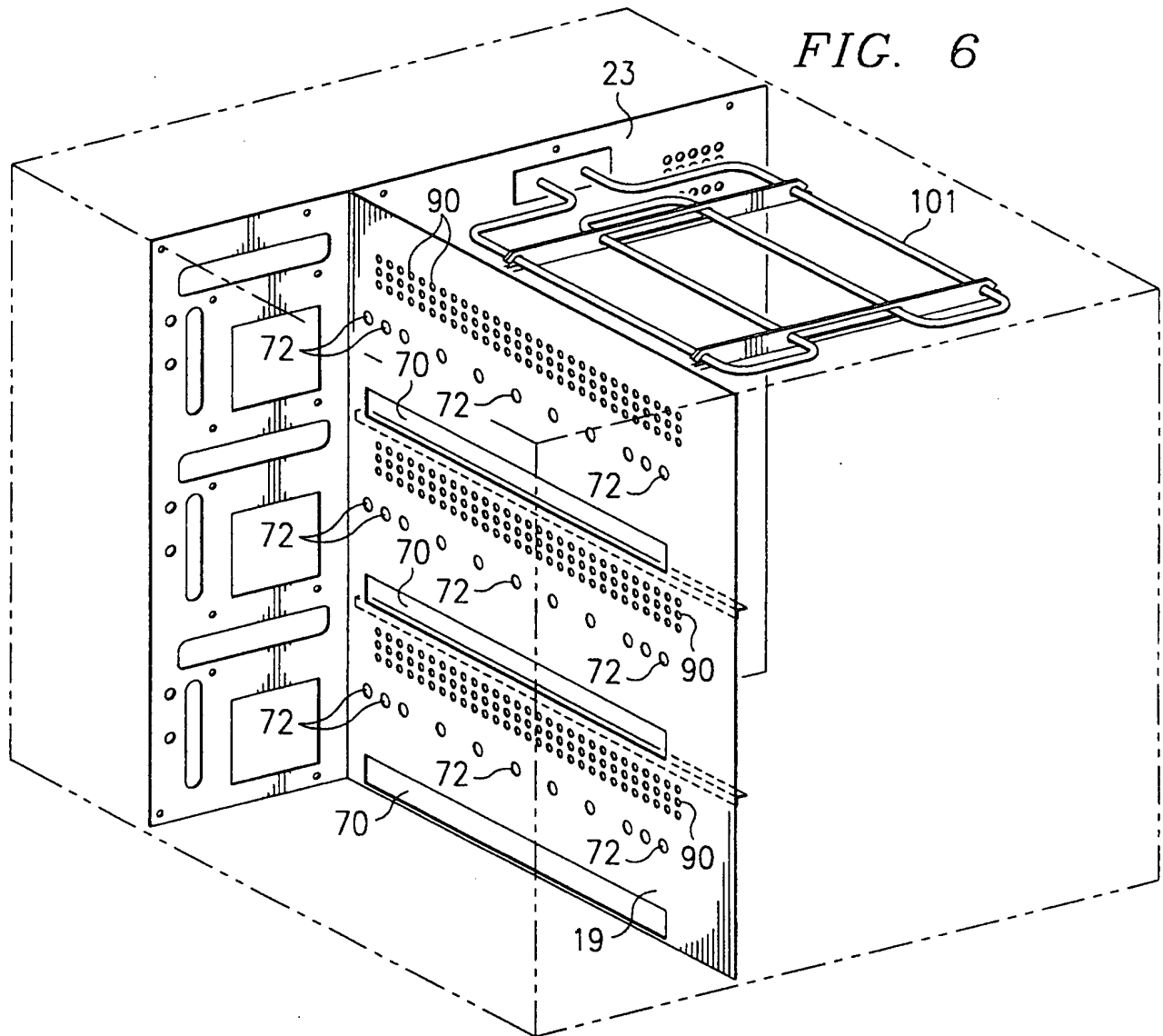
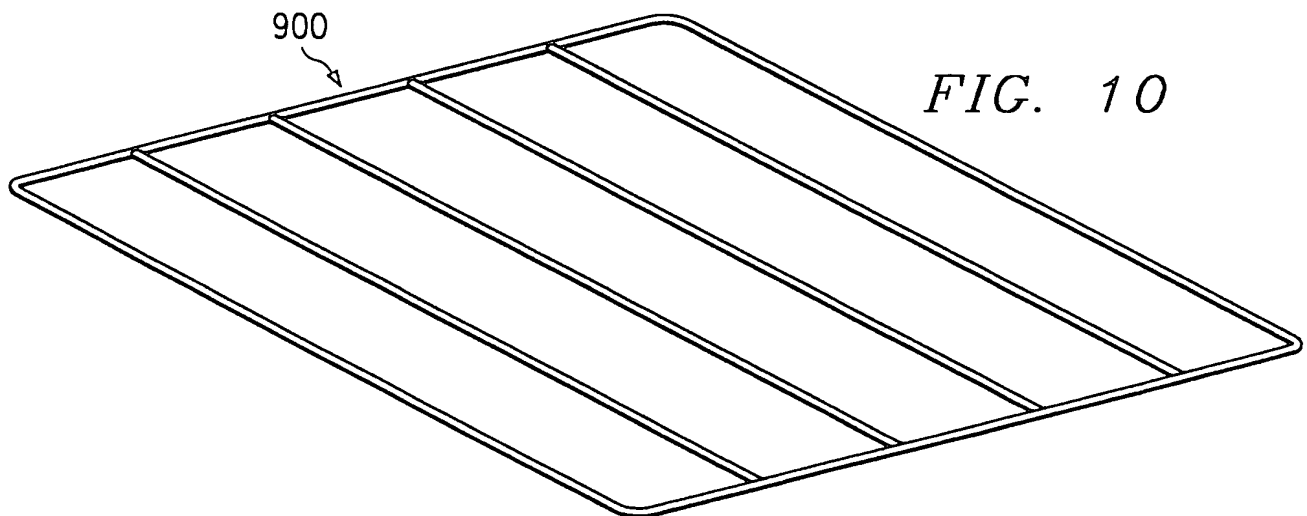
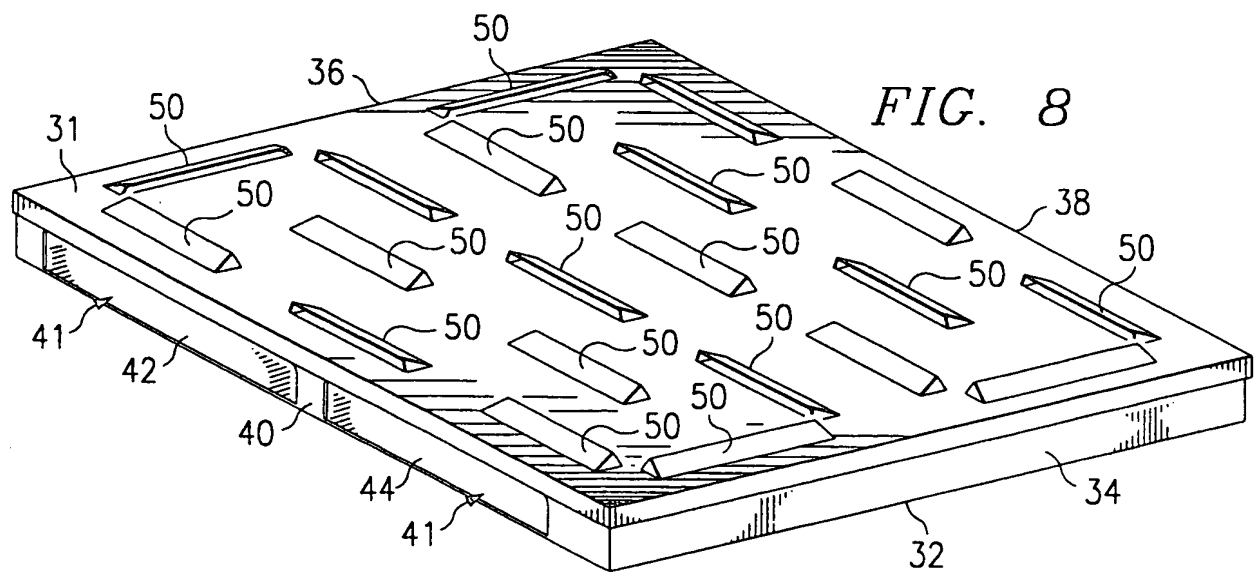
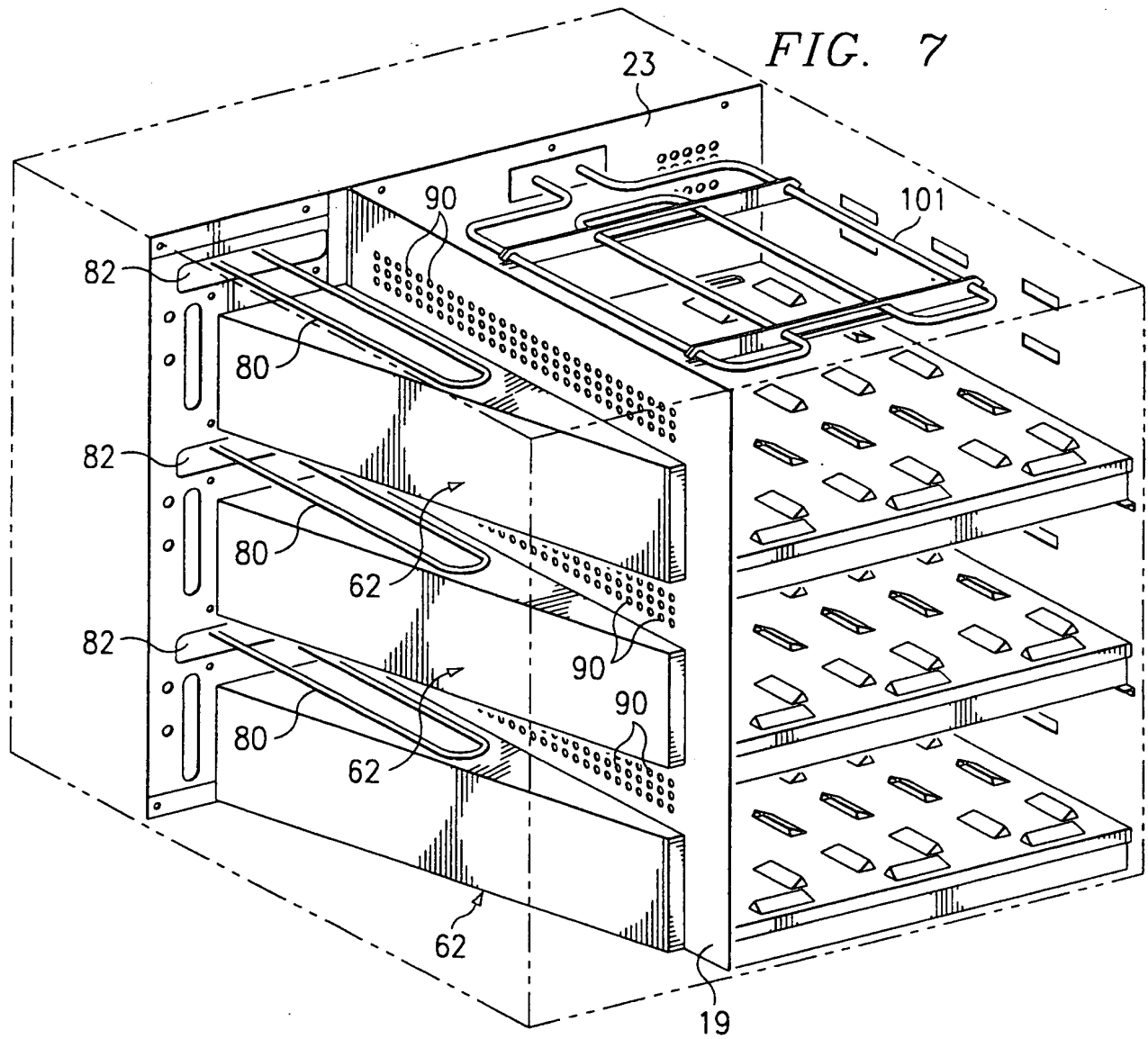


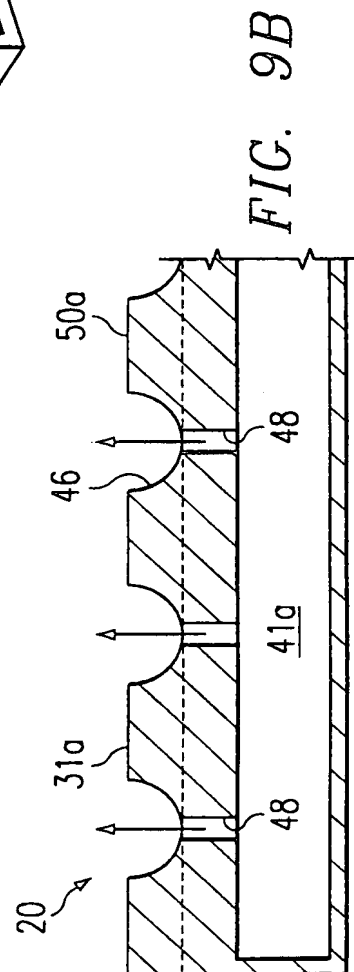
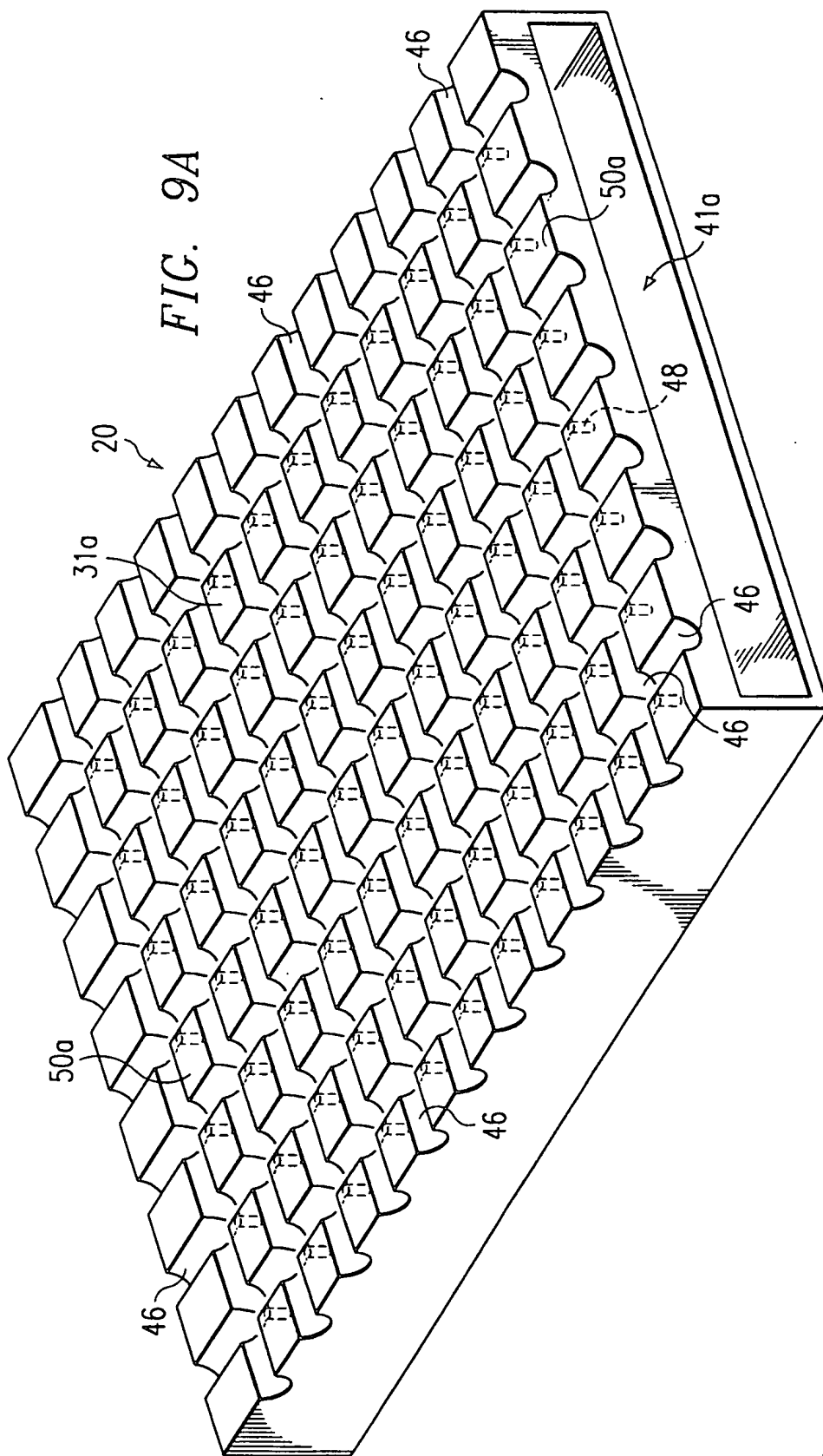
FIG. 10



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FIG. 13B

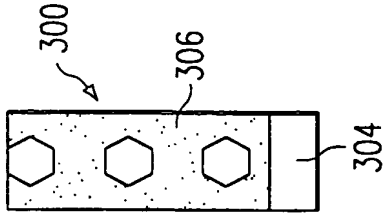


FIG. 14

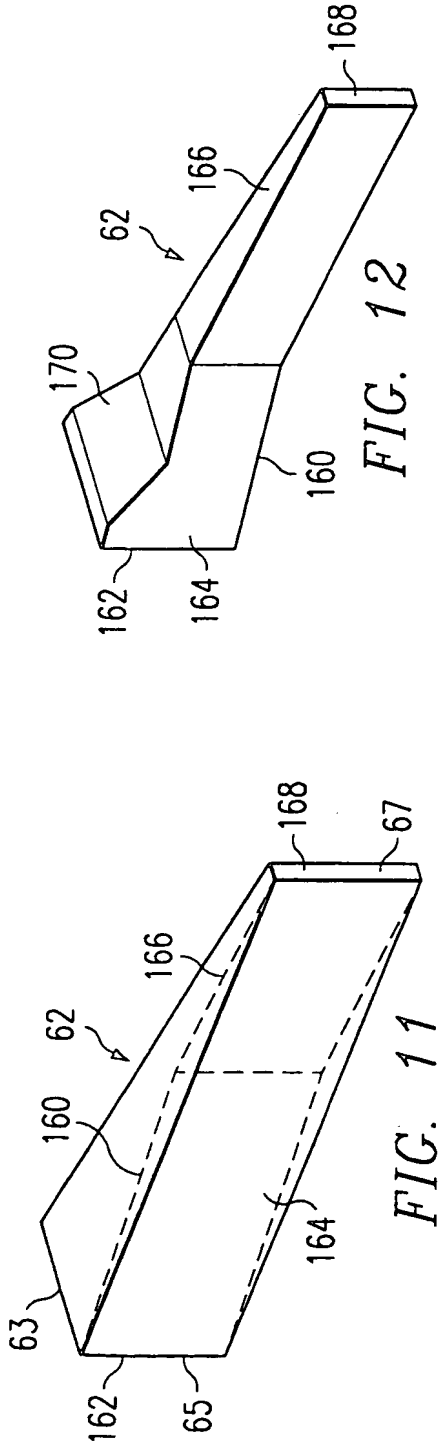
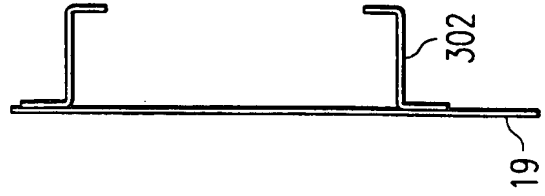


FIG. 13A

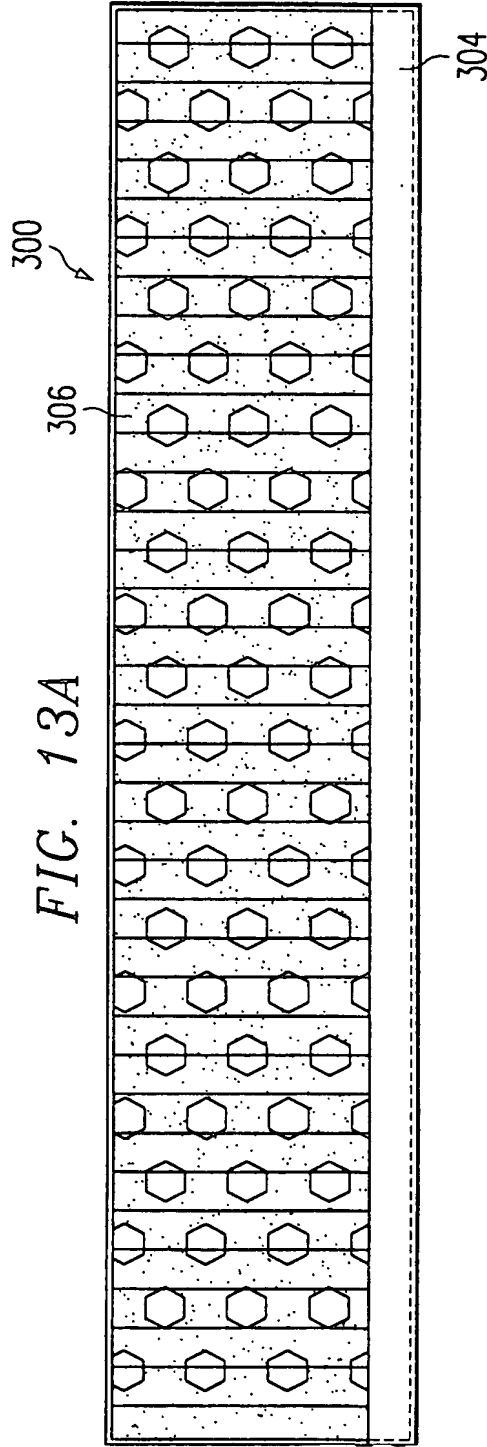
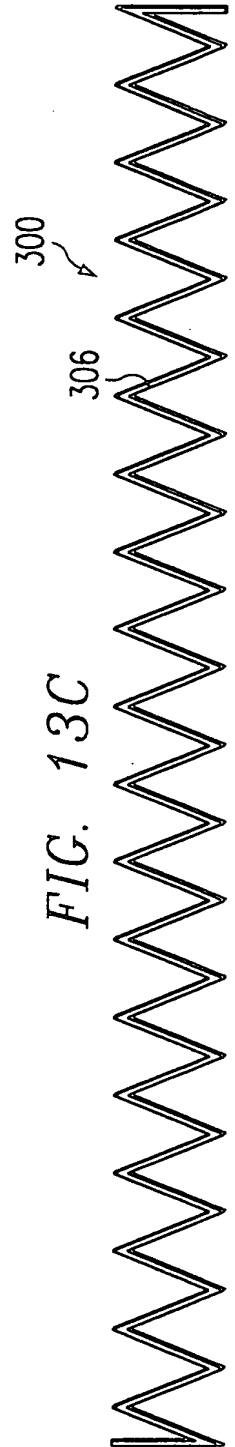
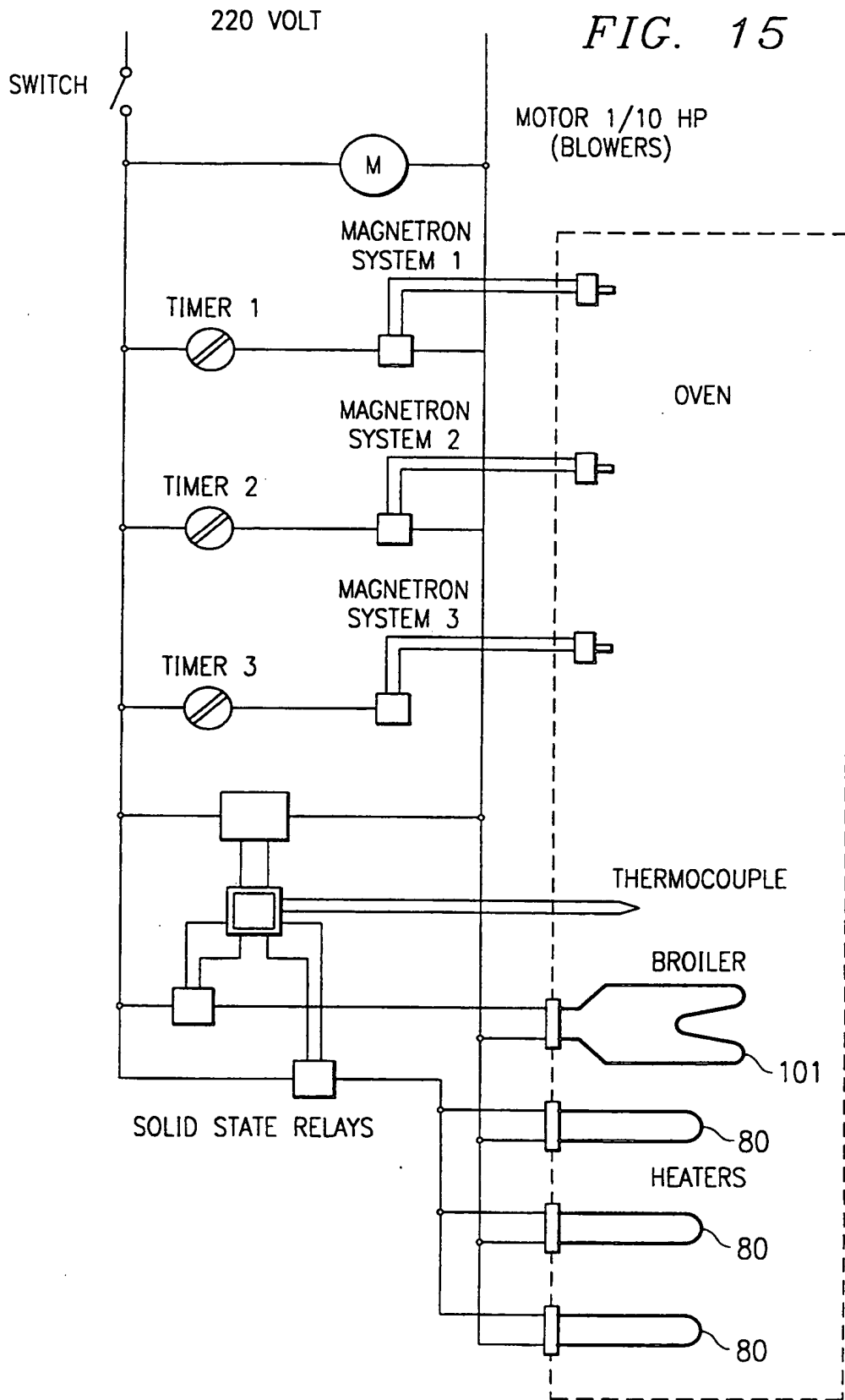


FIG. 13C



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FIG. 15



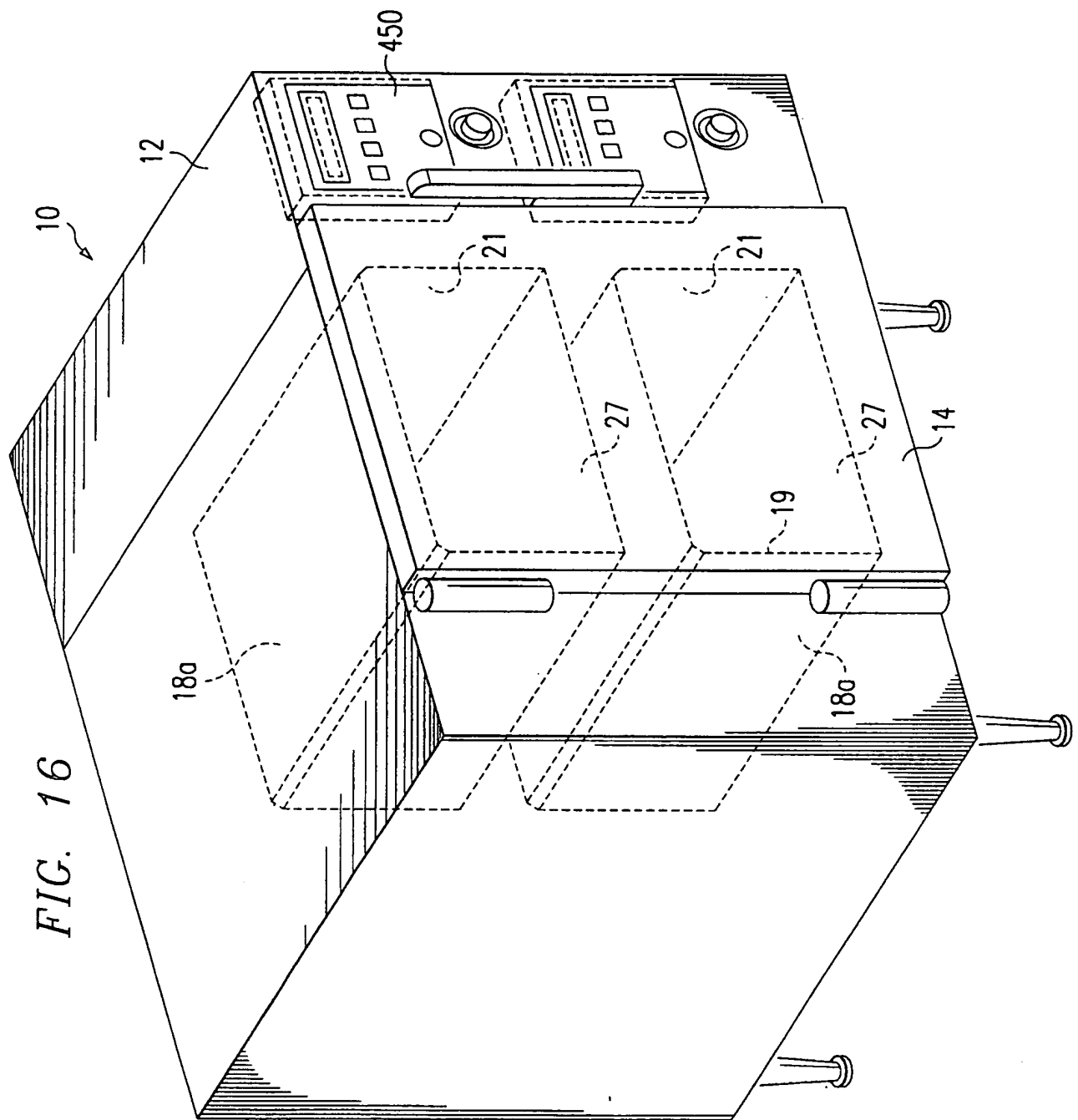
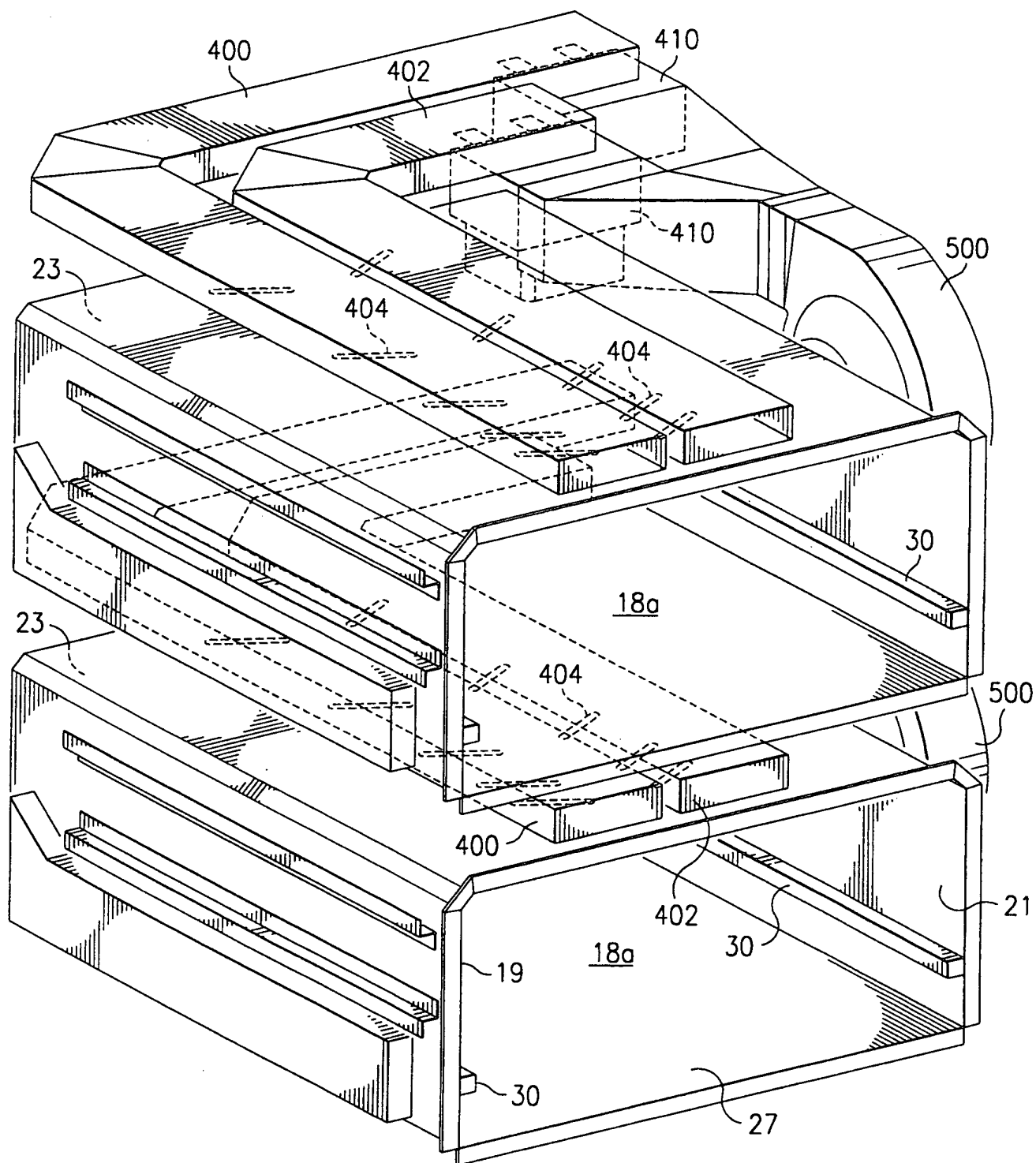


FIG. 17



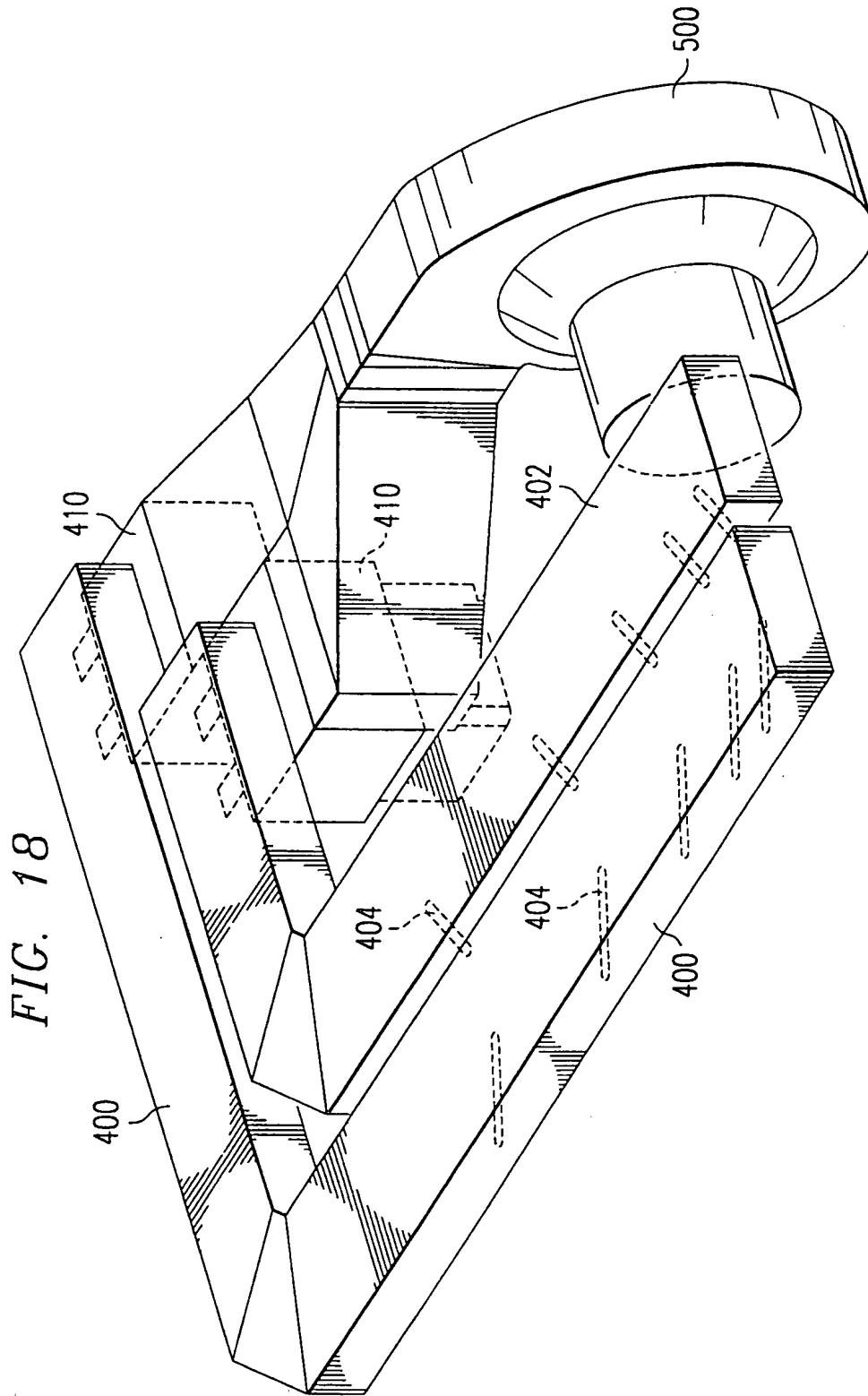
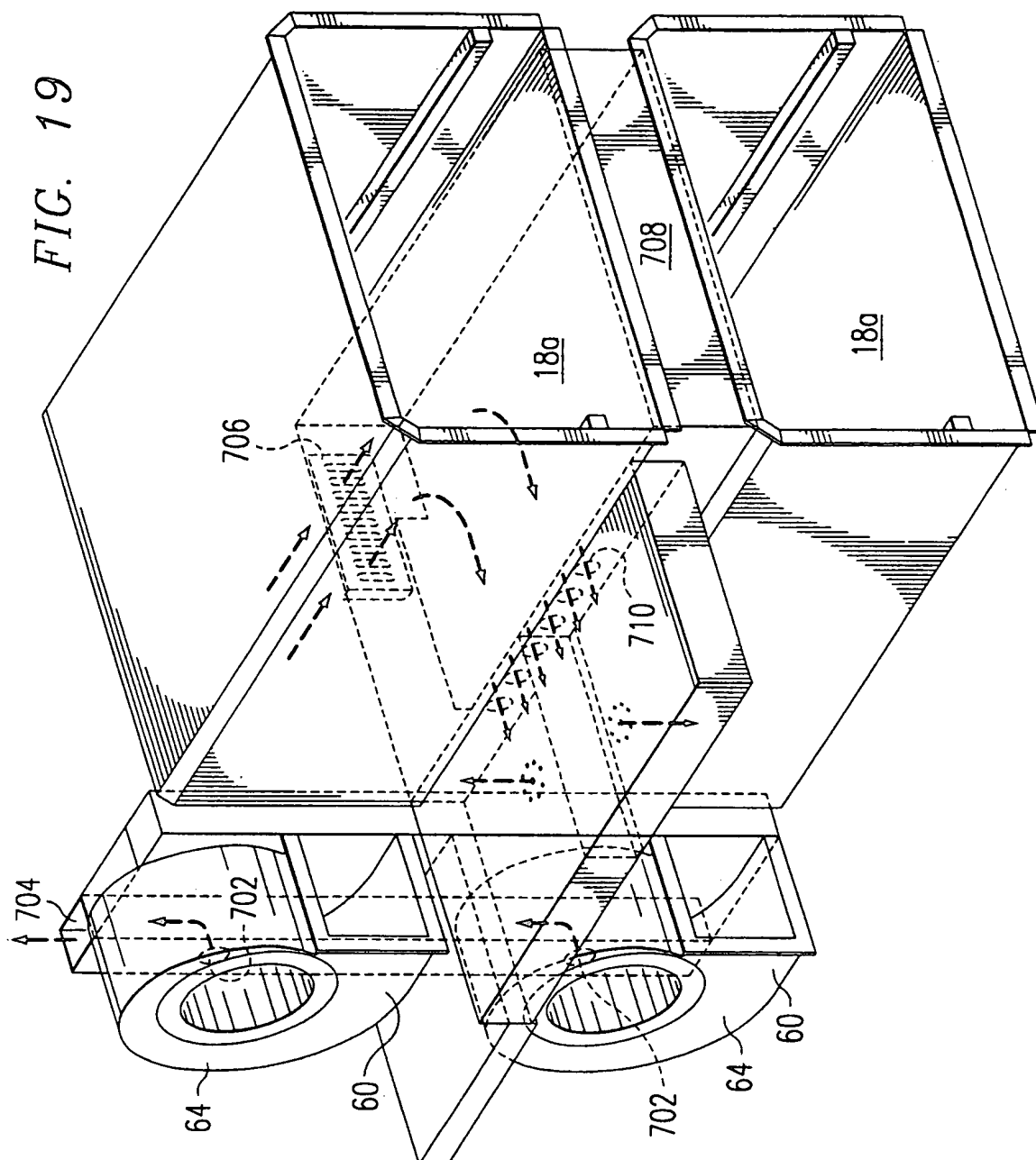
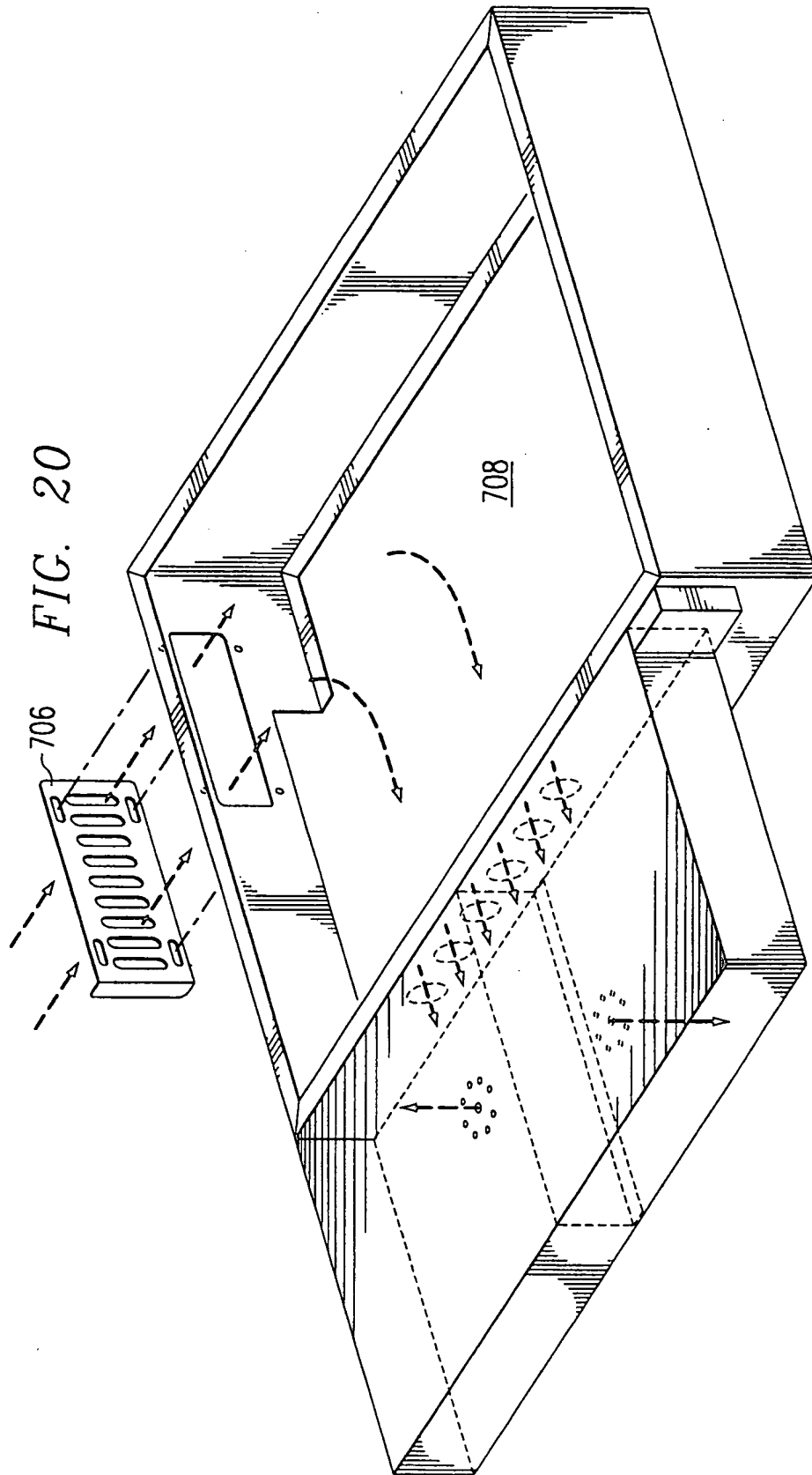


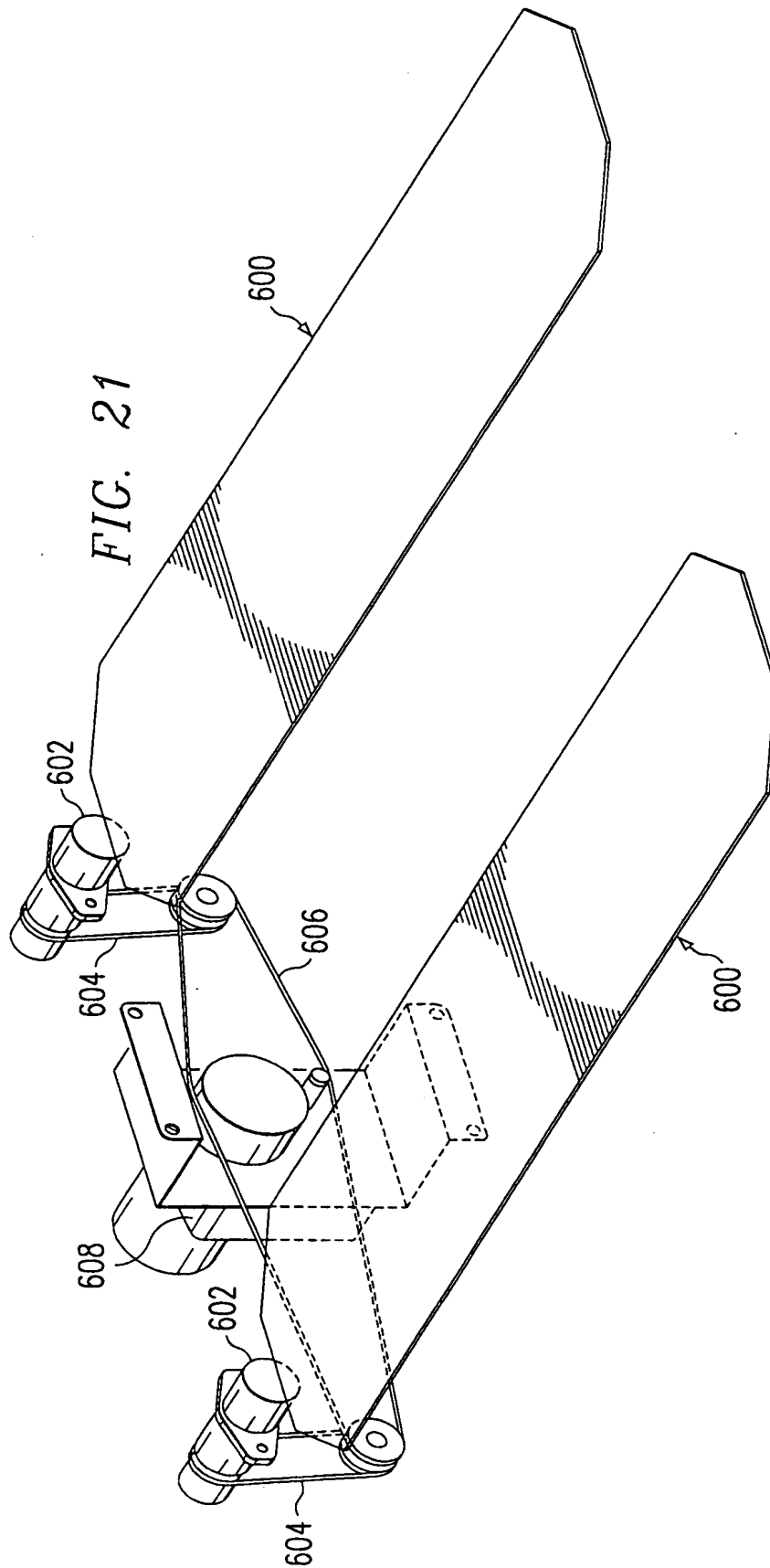
FIG. 19



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INTERNATIONAL SEARCH REPORT

Int ernational Application No

PCT/US 00/10624

A. CLASSIFICATION OF SUBJECT MATTER

IPC 7 H05B6/80

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 H05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal, PAJ

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 4 691 088 A (EKE KENNETH I) 1 September 1987 (1987-09-01) column 1, line 32 -column 2, line 14; figures	1
A	EP 0 429 822 A (ZANUSSI GRANDI IMPIANTI SPA) 5 June 1991 (1991-06-05) column 1, line 1 -column 3, line 56; figures 1,2-2C,6	1
A	WO 94 16606 A (GOMEZ JULIO ANTONIO) 4 August 1994 (1994-08-04) page 2, line 5 - line 28; figures	1
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Patent family members are listed in annex.

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Date of the actual completion of the international search

8 August 2000

Date of mailing of the international search report

17/08/2000

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European Patent Office, P.B. 5818 Patentaan 2
NL - 2280 HV Rijswijk
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INTERNATIONAL SEARCH REPORT

Int'l Application No

PCT/US 00/10624

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Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	<p>PATENT ABSTRACTS OF JAPAN vol. 005, no. 203 (M-103), 23 December 1981 (1981-12-23) & JP 56 119425 A (SANYO ELECTRIC CO LTD), 19 September 1981 (1981-09-19) abstract</p> <p>-----</p>	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/US 00/10624

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